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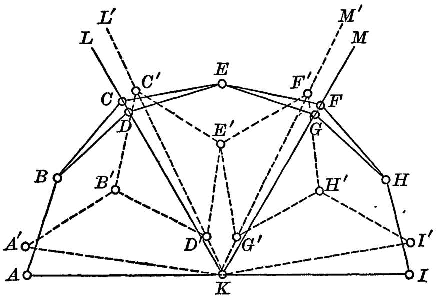
The last result was incorrectly stated by the Proposer.

Also solved by Herbert N. Carleton, J. A. Caparo, F. L. Griffin, Frank R. Morris, G. W. Hartwell, C. E. Horne, H. C. Feemster, Horace Olson, J. V. Balch, H. L. Agard, and the Proposer.

GEOMETRY.

427. Proposed by F. CAJORI, Colorado College.

In S. Gross's linkage for trisection of angles, shown in the figure (KL' and KM' being the trisectors of $A'KI'$), C is fixed on KL, also F on KM; at starting, C and D coincide, also F and G; D slides on KL, G slides simultaneously on KM; if E moves along a perpendicular to AI erected at K, find the loci of B and D.



Solution by J. W. Clawson, Collegeville, Pa.

Denote length of KC by b, $EC = CB = BA$ by a. Now $KA = b$, and, projecting the broken line $KCBA$ on KA,

$$b \cos \pi/3 + a \cos \pi/4 + a \cos 5\pi/12 = b.$$

Hence

$$b = 2a \cos \pi/12.$$

Denote length of KD' at any time by r, angle EKD' by θ, angle $E'C'K = E'D'C'$ by ψ. Then $r + 2a \cos \psi = b$. But, by the law of sines,

$$\frac{\sin(\theta + \psi)}{\sin \theta} = \frac{b}{a}.$$

Solving for $\cos \psi$,

$$\cos \psi = \frac{b}{a} \sin^2 \theta \pm \frac{\cos \theta}{a} \sqrt{a^2 - b^2 \sin^2 \theta}.$$

Hence,

$$r - b + 2b \sin^2 \theta = \mp 2 \cos \theta \sqrt{a^2 - b^2 \sin^2 \theta},$$

i. e.,

$$(r - b \cos 2\theta)^2 = 4 \cos^2 \theta (a^2 - b^2 \sin^2 \theta).$$

This is the polar (r, θ) equation of the locus of D' with respect to KE as initial line and K as pole.

Again, by the law of cosines, $KB'^2 = b^2 + a^2 - 2ab \cos \psi$. Denote length of KB' by ρ and $\angle EKB'$ by ϕ. The equation just written becomes

$$(\rho^2 - a^2 - b^2 \cos \phi)^2 = 2b^2(1 + \cos \phi) \left\{ a^2 - b^2 \frac{1 - \cos \phi}{2} \right\}.$$

This is the polar (ρ, ϕ) equation of the locus of B' where KE is initial line and K is pole.

463. Proposed by NATHAN ALTSHILLER, University of Washington, Seattle.

Through a given point, to draw a line that cuts off on the sides of a given angle two segments the sum of which has a given value.